INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: An Accurate and Efficient Varying Order NURBS Discretization Method for Isogeometric Analysis of Contact Problems

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SHORT ABSTRACT

In this work, a new varying order based NURBS discretization is proposed to enhance the performance of isogeometric analysis (IGA) technique within the framework of computational contact mechanics. The proposed method enables the order elevation based refinement of a NURBS discretized geometry in a controlled manner. It allows the usage of higher order NURBS functions only for the evaluation of contact integrals. The minimum orders of NURBS capable of representing the complex shape geometries exactly are employed for the bulk computations. To achieve this, a higher-order NURBS layer is used as the contact boundary layer of an initially lower-order NURBS discretized geometry. The NURBS layer is constructed using different surface refinement strategies such that it is accompanied by a large number of additional degrees of freedom and matches with the bulk parameterization. Further, a Gauss-point-to-surface contact algorithm with the penalty method is combined with the presented methodology towards developing a simple yet computationally efficient technique for isogeometric contact analysis. In order to demonstrate the efficacy and capabilities of the proposed method, various numerical examples involving small and large deformation contact between deformable bodies in two- as well as three-dimensional settings with or without accounting friction are considered. In addition, an adhesive peeling problem is analyzed to demonstrate its performance for the peeling computations. The results with the existing standard NURBS-based discretizations are used for the comparative assessment. The obtained results show that with the proposed method, much higher accuracy can be achieved even with a coarse mesh as compared to the existing NURBS discretization approach. It exhibits a major gain in numerical efficiency without the loss of stability, robustness, and the intrinsic features of the NURBS-based IGA technique for a similar accuracy level.